

CONTAINER WITH INTEGRAL HANDLE, PREFORM
AND METHOD OF MANUFACTURE

INTRODUCTION

5 This invention relates to a container with integral
handle, preform from which the container is biaxially blown
and a method of manufacture thereof.

BACKGROUND OF THE INVENTION

09508353-110600
10 Attempts have been made to incorporate integral
handles in PET and like injection blow moulded containers -
for example see US 4,629,598 to Thompson, assigned to Tri-
Tech Systems International, Inc. The parison from which
the handled bottles of US 4,629,598 are produced is
illustrated in Fig. 1. To date, however, attempts to
15 produce a practical, mass produced version of this
arrangement have been unsuccessful. Instead, the best that
appears to have been done in commercial practice is an
arrangement whereby the blown containers are arranged to
accept a clip on or snap on handle in a separate production
step after the container itself is formed. See for example
20 WO82/02371 and WO82/02370, both to Thompson.

Injection-stretch-blow moulding is a process in which
the parison is stretched both axially and radially,
resulting in biaxial orientation.

25 Biaxial orientation provides increased tensile
strength (top load), less permeation due to tighter
alignment of the molecules, and improved drop impact,
clarity, and lightweighting of the container.

30 Not all thermoplastics can be oriented. The major
thermoplastics used are polyethylene terephthalate (PET),
polyacrylonitrile (PAN), polyvinyl chloride (PVC), and
polypropylene (PP). PET is by far the largest volume
material, followed by PVC, PP, and PAN.

35 The amorphous materials, e.g., PET, with a wide range
of thermoplasticity are easier to stretch-blow than the
partially crystalline types such as PP. Approximate melt

-2-

and stretch temperatures to yield maximum container properties are:

	Material	Melt, Degrees C.	Stretch, Degrees C.
5	PET	280	107
	PVC	180	120
	PAN	210	120
	PP	240	160

There are basically two types of processes for stretch-blow moulding: 1) single-stage in which preforms are made and bottles blown on the same machine, and 2) two-stage in which preforms are made on one machine and blown later on another machine.

Single-stage equipment is capable of processing PVC, PET, and PP. Once the parison is formed (either extruded or injection moulded), it passes through conditioning stations which bring it to the proper orientation temperature. The single-stage system allows the process to proceed from raw material to finished product in one machine, but since tooling cannot be easily changed, the process is best suited for dedicated applications and low volumes.

Oriented PVC containers most commonly are made on single-stage, extrusion-type machines. The parison is extruded on either single- or double-head units. Temperature conditioning, stretching, and thread forming are done in a variety of ways depending on the design of the machine. Many of the processes presently in use are proprietary.

Many oriented PET containers are produced on single-stage machines. Preforms are first injection moulded, then transferred to a temperature conditioning station, then to the blow moulding operation where the preforms are stretch-blown into bottles, and finally to an eject station.

With the two-stage process, processing parameters for both preform manufacturing and bottle blowing can be optimized. A processor does not have to make compromises

-3-

for preform design and weight, production rates, and bottle quality as he does on single-stage equipment. He can either make or buy preforms. And if he chooses to make them, he can do so in one or more locations suitable to his market. Both high-output machines and low output machines are available. Two stage extrusion-type machines generally are used to make oriented PP bottles. In a typical process, preforms are re-extruded, cooled, cut to length, reheated, stretched while the neck finish is being trimmed, and ejected. The two-stage process is the lowest-cost method to produce oriented PET containers. The two-stage process, which permits injection moulding of the preform and then shipping to blow moulding locations, has allowed companies to become preform producers and to sell to blow moulding producers. Thus companies that wish to enter the market with oriented PET containers can minimise their capital requirements. Two-stage stretch-blow moulding also is being used for production of oriented PVC containers. Preform design and its relationship to the final container remains the most critical factor. The proper stretch ratios in the axial and hoop directions must be met if the container is to properly package its intended product.

Material	Stretch Ratios	Orientation Temp.Deg.F
PET	16/1	195-240
PVC	7/1	210-240
PAN	9/1	220-260
PP	6/1	260-280

It is an object of the present invention to produce a practical, readily implementable injection, stretch blow moulded container made from an orientable thermoplastics material incorporating a handle which is formed during and as part of the said injection, stretch blow moulding operation.

SUMMARY OF THE INVENTION

According to one aspect of the invention, there is provided a preform for a container comprised of orientable

- 4 -

thermoplastic material and arranged so that the resultant blown container will include a handle or like support structure; said preform comprising a moulded structure having a neck portion and an expandable portion below the neck, said neck including a locating ring above the expandable portion and a solid stem of orientable thermoplastics material projecting from the preform and moulded integrally therewith which when the container is formed constitutes the handle.

Preferably said stem projects from said locating ring and from a temperature transition zone located immediately below said ring.

According to another aspect of the invention there is provided a method of forming a container having an integral handle; said method comprising:

(a) forming a preform having a neck portion and an expandable portion below the neck portion, said neck portion including a locating ring above the expandable portion and a solid stem of orientable thermoplastics material projecting from the preform and moulded integrally therewith, and

(b) performing a blow moulding operation on said preform to expand the expandable portion to form the body of the container.

Preferably said stem projects from said locating ring and from a temperature transition zone located immediately below said ring.

In a preferred form of the invention, the neck portion and integral handle are subjected to a crystallisation step.

Preferably, the blow moulding operation includes supporting the stem whilst the preform is blown in a manner whereby at least a portion of the external side of the tube expands to encircle at least a lower portion of the stem so as to form an enclosed grip portion between the external side and the solid stem.

-5-

It is preferred that the enclosed grip portion allows at least two fingers of the adult human hand to pass therethrough.

5 In a particularly preferred form of the invention the stem is formed so as to have an I-shaped cross-section at least throughout that portion of the stem where it projects from the external side of said tube. The handle may be curved to provide additional strength.

10 In a further broad form of the invention there is provided a parison for an injection stretch blow moulding process, said parison formed by an injection process including two separate points of injection.

09508353-110600
15 Preferably a first point of injection permits injection of non-recycled PET or like thermoplastics material. Preferably a second point of injection permits injection of PET or like thermoplastics material incorporating at least a portion of recycled material.

20 Preferably said first point of injection is for the formation of that part of the parison which will be stretched during a stretch blow moulding operation on the parison. Preferably said second point of injection is for the formation of those parts of said parison which will remain unexpanded or substantially unexpanded in a stretch blow moulding operation on said parison.

25 In yet a further broad form of the invention there is provided a container manufactured from a two stage injection stretch blow moulding process, said container including a graspable handle affixed at at least a first point and a second point to said container so as to form an enclosed area between the handle and the bottle and through
30 which the fingers of a human hand may be passed.

35 Preferably said first point of connection comprises an integral connection between the handle and the container and is formed in said first step of said two step operation.

Preferably said second point of connection is formed during said second step of said two step operation.

-6-

Preferably said handle at said second point of interconnection includes a bulbous portion adapted to be at least partially enfolded by a portion of said container as it is blown during said second step of said two step operation whereby a mechanically interlocked connection is formed at said second point of connection of said handle to said container.

In particular preferred forms said bulbous portion comprises one of an upwardly extending hook, a downwardly extending hook, a bulb or a combination of one or more thereof.

In a further broad form of the invention there is provided a method of production of an integral handle PET container including the step of shrouding a handle stem portion of a preform during preheating of said preform preparatory to a stretch blow moulding step.

Preferably the handle stem is fully supported in a mould cavity against movement during the stretch blow moulding operation.

In a further broad form of the invention there is provided a container comprised of biaxially orientable thermoplastic material manufactured from a two stage injection stretch blow moulding process; said two stage process comprising a first stage in which a preform is manufactured and a second stage in which said preform is reheated and biaxially stretched to form said container; said container including a graspable handle affixed at at least a first point of connection and a second point of connection to said container so as to form an enclosed area between said handle and said container and through which at least two fingers of a human hand can pass; and wherein said first point of connection comprises an integral connection between the handle and the container and is formed in said first stage of said two stage process.

- 7 -

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example, with reference to the accompanying drawings, in which:

- 5 Fig. 1 is a side view of a prior art parison,
Fig. 2 is a side view of a parison incorporating features according to embodiments of the present invention,
Fig. 3 is a partial side elevational view of a blow moulded PET container formed from a preform according to one
10 embodiment of the invention;
Fig. 4 illustrates the steps of formation of a parison according to another embodiment of the invention.
Fig. 5A is a side view of a preform according to a further embodiment of the invention;
15 Fig. 5B is a side view of a container formed from the preform of Fig. 5A.
Fig. 6 is a side view of a die in open position for manufacture of a preform;
Fig. 7 is the die of Fig. 6 in closed position;
20 Fig. 8 is a side view of the die of Figs. 6 and 7 showing the stem of the preform located therein,
Fig. 9 is a top view of a two stage injection, blow mould machine adapted to receive preforms and biaxially orient them into blown containers according to an embodiment of
25 the invention,
Fig. 10 is a side section view of a lifting, lowering and rotating mechanism for handle covers for use with the machine of Fig. 9,
Fig. 11 is an alternative side section view of the
30 mechanism of Fig. 10,
Fig. 12 is a side section, close up view of the machine of Fig. 9 showing a preform with handle cover lowered over the handle portion thereof,
Fig. 13A,B illustrates first and second side section views
35 of a preform adapted for loading into the machine of Fig. 9,
Fig. 14 is a perspective view of the preform of Fig. 13,

-8-

Fig. 15 is a perspective view of a container blown from the preform of Fig. 14 on the machine of Fig. 9,

Fig. 16 is a plan view of a half mould adapted for blowing preforms on the machine of Fig. 9,

5 Fig. 17 is a top view of the mould of Fig. 16 with a preform inserted therein ready for blowing on the machine of Fig. 9,

Fig. 18 is a bottom view of Fig. 17 with both half moulds in opposed relationship,

10 Fig. 19 is a further bottom view of Fig. 17 showing the preform in the position of Fig. 17,

Fig. 20 is a section view through the half mould of Fig. 16,

Fig. 21 is a section view through the mould of Fig. 16,

15 Fig. 22 is a side view of the container of Fig. 15 blown in the mould of Fig. 19 from a preform as illustrated in Fig. 13 and 14,

Fig. 23 is a detail, side section view of the neck and top handle portion of the container of Fig. 22,

20 Fig. 24 is a side view of a preform incorporating an enlarged first non-expanding region according to a further embodiment of the invention,

Fig. 25 is an alternative side view of the preform of Fig. 24,

25 Fig. 26 is a side view of a container blown from the preform of Fig. 24 on the machine of Fig. 9,

Fig. 27 is a perspective view of the preform of Fig. 24,

Fig. 28 is a perspective view of the container of Fig. 26,

30 Fig. 29 is a side view of yet a further alternative embodiment of a preform incorporating a lengthened or enlarged first non-expanding zone and adapted for blowing on the machine of Fig. 9,

Fig. 30 is a side view of a container blown from the preform of Fig. 29 on the machine of Fig. 9,

35 Fig. 31 is a plan view of a half mould for blowing the preform of Fig. 24,

-9-

Fig. 32 is a plan view of the half mould of Fig. 31 with the preform of Fig. 24 inserted therein ready for blowing on the machine of Fig. 9,

5 Fig. 33 is a side section view of a container blown in the mould of Fig. 32 and

Fig. 34 is a detail side section view of the neck and top handle portion of the container of Fig. 33.

Fig. 35 is a first perspective view of a container according to a further embodiment of the invention particularly adapted to resist high internal pressures,

10 Fig. 36 is a second perspective view of the container of Fig. 35,

Fig. 37 is a first side view of the container of Fig. 35,

Fig. 38 is a second side view of the container of Fig. 35,

15 Fig. 39 is a plan view of the container of Fig. 35,

Fig. 40 is a side view of a preform from which the container of Fig. 35 can be blown,

Fig. 41 is a perspective view of the preform of Fig. 40,

20 Fig. 42 is a perspective view of a container with strap connected handle according to a further embodiment of the invention, and

Fig. 43 is a side view of a preform from which the container of Fig. 42 can be blown.

DETAILED DESCRIPTION OF THE DRAWINGS

25 A container 10 according to an embodiment of the invention is shown in Fig. 3. It includes a neck 11 and an expanded portion 12.

The neck 11 has a threaded portion 13 and a locating ring 14. Moulded integrally with the ring 14 is a stem 15 having a first portion 15a extending outwardly from the ring 14 and a second portion 15b so inclined to the first portion 15a that it is nearly parallel to a vertical axis of the container 10. In this instance, the first portion 15a subtends an angle of slightly more than 45° to the wall 20 and the second portion subtends an angle of about 20° to the wall 20.

-10-

The particular shape of the stem 15 is selected so that when formed as a handle it may be grasped by fingers of the human hand.

5 The stem 15 terminates in a stem end 16 which faces generally downwardly in the general direction of closed end of the container 10.

10 In this instance, the stem 15 is of I-shaped cross-section to combat unwanted effects arising at or near junction 17 of stem 15 with the ring 14 following a blowing operation on the preform 10.

These unwanted effects particularly include stress effects and air inclusions resulting from non-uniform cooling through preform volumes of differing cross-section.

15 In this embodiment of the invention, the preform is made from PET and is prepared utilizing a heated mould.

20 In order to produce the container 10, the parison or preform 26 (see Fig. 2) according to an embodiment of the invention can be placed in a blow moulding machine (not shown) and blow moulded according to bi-axial orientation blow moulding techniques with the neck 11 being held in a mould in such a way as not to expand. Initially, the expandable portion of the preform below the neck can be mechanically stretched downwardly to the bottom of the mould and then the bulk of the preform can be blown
25 outwardly by application of compressed air to the extent that a support portion 18 is formed around the stem end 16 such that an enclosed area 19 is formed between wall 20 of the container 10 and the stem 15 in the process of the formation by blow moulding of container 10.

30 In a particular preferred form of the invention, the enclosed area 19 is of sufficient cross-sectional area to allow at least two fingers of a human hand to be inserted therethrough and to grasp handle 15 so as to support the container 10.

35 The blow moulding operation is carried out in such a way so as to provide a bottle or container having optimum strength by achieving biaxial orientation of the molecules

-11-

of the preferred PET material as well as improved barrier properties to reduce oxidation.

5 In accordance with an embodiment of the invention, the neck 11 and handle 15 can be crystallised by over-heating those parts of the preform. The crystallisation of the handle increases its rigidity which assists orientation of the preform and permits the use of less material.

10 Crystallisation of the neck and handle can be carried out by running hot oil over the neck and handle, applying an open flame or by blowing hot air.

The location of the handle 15 on the ring 14 ensures that there is minimum interference to the blow moulding process applied to the remainder of the preform. Either a one stage or two stage process can be used.

15 Detailed Description of Further Embodiments

Fig. 1 illustrates the prior art preform or parison 21 of US 4,629,598. The concept of this prior art disclosure is to form a handle portion 23 from the locating ring of non-expandable portion 22 of the parison 21.

20 With reference to Fig. 2 and with reference to the detailed description of the preferred embodiment this arrangement of Fig. 1 is modified according to the present invention in a number of respects.

25 Insets 2A, 2B and 2C show bulbous portions 27 forming part of stem end 16 in the shape, respectively of a downwardly extending hook 24a, a bulb 24b and an upwardly extending hook 24c.

30 These portions have in common a shape which is adapted to engage mechanically with a blown portion of the container 10 which is adapted to envelop the bulbous portion 27.

35 The process by which the second stage blow of the expandable portion 12 of parison 26 is effected so as to envelope the bulbous portion 27 of stem end 16 is a stretch blow, biaxial orientation process.

-12-

With reference to Fig. 4 a particular method of manufacture of the parison 26 according to another embodiment of the invention is illustrated. It includes a two stage process for the formation of the parison by an injection moulding process. In Stage 1 a first injection mould inlet 28 permits entry of plastics material for the formation of the expanded portion 12 of the parison 26 (expanded in the blow moulding stage of container formation, with reference to Fig. 3).

In a second stage of the injection moulding process for the formation of parison 26 a second injection mould inlet 29 permits entry of plastics material for the formation of the non-expandable portion 25 of parison 26.

The two stage injection arrangement is such that different plastics materials may be injected through first injection mould inlet 28 and second injection mould inlet 29.

In a particular preferred form the plastics material injected in first injection mould inlet 28 is non-recycled or substantially non-recycled plastics material whilst the plastics material injected into second injection mould inlet 29 is recycled or at least partially recycled plastics material.

This arrangement permits controlled use of proportions of recycled and non-recycled plastics material in order to achieve optimum economics in the construction of parison 26.

In a modification of this arrangement the Stage 2 step can include the production of two walls in the non-expandable portion 25 comprising inner wall 51 and outer wall 52. Inner wall 51 is made from virgin or non-contaminated PET material and acts as an insulation barrier with respect to wall 52 which can be made from recycled material 52. This dual wall arrangement can be produced by use of a sliding core arrangement as a modification in the die arrangement and process described with reference to Figs. 6, 7 and 8 later in this specification.

-13-

Of course the Stage 1 and Stage 2 steps of Fig. 4 can be interchanged in order.

5 A parison and resulting container according to a further embodiment of the invention are illustrated in Figs. 5A and B respectively. Like parts are numbered as for previous embodiments.

10 In this embodiment the parison 21 includes a locating ring 14 immediately below which is a first non-expanding region 30 and a second non-expanding region 31. The first non-expanding region 30 may itself be formed so as to be slightly raised or otherwise differentiated from the expandable portion of parison 21. Second non-expanding region 31 may not be differentiated from the expandable portion of parison 21 but, in use, the blowing operation
15 will be such as to ensure that the second non-expanding region 31 is not expanded in the blowing process.

20 In this case the stem 15 includes a first rib 32 integrally moulded with and extending from locating ring 14. The stem 15 also includes second rib 33 integrally moulded with and extending from second non-expanding region 31. Stem 15 further includes a rib connector 34 integrally moulded with and extending from first non-expanding region 30 and forming a continuous connection between first rib 32 and second rib 33 throughout the length of stem 15.

25 The parison 36 of Fig. 5A is then blown in the manner previously described to form the volume 35 of container 37 illustrated in Fig. 5B. The neck portion including stem 15, ring 14, first non-expanding region 30 and second non-expanding region 31 remain unexpanded whilst the expandable portion 36 of parison 36 is biaxially stretched to form the major volume 35 of container 37. The stem end 16 may
30 include the bulbous portions according to the previously described embodiments for connection to container 37 or, either alternatively or in addition can include the application of an adhesive material whereby a chemical bond
35 is formed between stem end 16 and the wall of container 37 by the use of a chemical intermediary.

-14-

In a modification of the embodiments of Fig. 5A and Fig. 5B first non-expanding region 30 and second non-expanding region 31 can form part of a single non-expanding region.

5 In yet a further modification second non-expanding region 31 can be located in the temperature transition zone of the container and wherein minor expansion during the blow moulding step may take place.

10 In yet a further modification both first non-expanding region 30 and second non-expanding region 31 may be located in the temperature transition zone immediately below the locating ring 14 and, again, minor expansion of these regions may take place during blowing.

15 With respect to the last two variations described advantage is taken of the observation that expansion at the temperature transition zone can be limited by appropriate mould design and process control whereby unwanted distortion effects caused by the rigid interconnection of this temperature transition zone 30, 31 via second rib 33 and rib connector 34 to ring 14 (or other non-expanding
20 portion of the neck 11) can be controlled.

In use preforms and containers blown therefrom can be manufactured as follows:

25 A preform is formed from orientable thermoplastics material, preferably PET or like material in an injection moulding process. Slidable dies are illustrated in Figs. 6, 7 and 8 and include a sliding core 40, sliding blocks 41, body 42, base 43, push block 44 and splits holder 45. Fig. 6 illustrates the die in open position, Fig. 7
30 illustrates the die in closed position and Fig. 8 illustrates a side view showing accommodation of the stem 14.

35 The completed preforms in a second and preferably separate step are subsequently passed to a stretch blow mould machine where the preforms are first reheated to the appropriate transition temperature (refer introduction). The non-expandable portion of the preform including

-15-

locating ring 14 and stem 15 are shielded substantially from the reheat process by appropriate guarding. In most instances there is likely to be a temperature transition zone in the region 30, 31 described with reference to Figs. 5A, 5B.

The reheated preform is then placed in a mould and biaxially stretched and the expandable portion blown to full size utilising processes known in the art. During this process the preform is supported at neck 14 and may also be supported at stem 15. Stem 15 does not take part in the blow process although its stem end 16 may be partially enveloped by an external wall of the blown container.

DETAILED DESCRIPTION OF METHODS OF MANUFACTURE INCORPORATING MODIFIED TWO STAGE STRETCH BLOW MOULDING MACHINES

Fig. 9 illustrates a modified two stage stretch blow mould machine 110 adapted to stretch blow mould (including biaxial orientation) of the preforms of previous embodiments and preforms of further embodiments to be described below with reference to later figures.

The machine 110 comprises a first carousel 111 adapted to receive integral handle preforms 112 from inclined chute 113 into apertures 114 spaced around the periphery thereof.

As first carousel 111 rotates it moves, via apertures 114 the preforms 112 from the chute 113 to a second carousel loading position where the preform 112 is transferred to a spindle 115 mounted near the periphery of second carousel 116.

A sector of approximately 270° of second carousel 116 is arranged as a preheating tunnel 117 where the preforms 112 are progressively heated by a heating bank mounted in opposed relationship to the path of travel of the preforms.

The suitably preheated preforms 112 are loaded consecutively into apertures 119 of a third carousel 120 which acts as a transfer mechanism to both suitably orient the preforms 112 about their longitudinal axis and present

-16-

them to a mould cavity 121 comprising first half mould 122 and second half mould 123.

It should be noted that during their time in the preheating tunnel 117 the preforms 112 are rotated about their longitudinal axis by spindles 115 and have a handle shroud 124 mounted over the preform stem which subsequently forms a handle for blown container 125. Details of the rotation of spindles 115 and the shrouding of the preform stem are discussed more fully with reference to Figs. 10, 11 and 12.

Mould cavities 121 are mounted on the periphery of a fourth carousel 126. During their travel through approximately a 270° sector the half moulds 122, 123 rotate to a closed position about their axis 127 and, whilst closed, the preform 112 enclosed therein is blown and biaxially stretched in known manner in order to produce an integral handle, blown container 125. This container 125 is ejected as illustrated when the half moulds open preparatory to receiving a fresh, preheated preform 112.

With reference to Fig. 10 further detail is shown of spindles 115 and handle shrouds 124 and their manner of operation upon and in relation to preforms 112 whilst passing through preheating tunnel 117 on second carousel 116.

The spindles 115 are rotated by band drive 128 so as to, in one embodiment, rotate the preforms 112 through approximately four full axial rotations during their passage through the preheating tunnel 117.

Whilst in the preheating tunnel 117 a handle shroud 124 is lowered over the free end 129 of handle stem 130 so as to fully shroud the handle stem 130 as best seen in greater detail in Fig. 12.

The shroud 124, in one preferred form, is cylindrical save for a fluted open mouth 131 best seen in Fig. 12. The fluted mouth 131 assists in ensuring maximal shrouding of handle stem 130 and also assists in guiding the shroud 124 onto the free end 129 of stem 130.

-17-

Lifting and lowering of the shroud 124 is effected through a shroud support stem 132 which is suspended from a cam follower 133 adapted to travel on cam 134.

5 The stems 132 are themselves rotated by band drive 135 so as to follow the rotation of spindles 115. As best seen in end view of Fig. 11 the shroud support stem 132 is offset from the cam follower stem 136 by virtue of being mounted near the periphery of platten 137.

10 As cam follower 133 rides up cam 134 it pulls handle shroud 124 up with it by virtue of the connecting link comprising shroud support stem 132, platten 137 and cam follower stem 136.

15 Cam follower stem 136 can comprise a telescoped arrangement allowing relative axial rotation between two component, telescoping parts thereof.

The handle shroud 124 can comprise alternative shapes other than cylindrical, for example an oval cross section is possible although the cylindrical arrangement having a circular cross section is preferred.

20 The handle shroud 124 is preferably made of insulating material such as a ceramic material and is covered on an exterior surface 138, in a preferred version, with a heat reflecting material which, ideally, is also light reflecting.

25 In use the reflective surface 138 causes light and heat emanating from heating bank 118 to be reflected thereof whereby two functions are performed. The first function involves protecting the handle stem 130 from heat. The second function is to reflect heat and light in the
30 direction of that portion of the preform closest to the handle stem 130 so that it is evenly heated and tends not to be shadowed by the stem 130.

35 In one particular form the handle shrouds 124 can be cooled by an air or nitrogen blast (not shown) directed at them whilst they are lifted clear of the preform 112. This will assist to prevent radiated and/or convected heat building up within the cavity 139 of the shroud 124.

-18-

Figs 13-23 illustrate details of a preform, mould and container blown therefrom and therein by the machine of Fig. 9. With reference to Fig. 13, in a preferred version, dimension A is greater than dimension B thereby to discourage tangling of preforms prior to loading into chute 113.

It will be observed that the top end of the handle is located close to the locating ring in this version. It will also be noted that the stem of the preform which subsequently constitutes the handle of the blown container is fully supported within the half mould during the entire blowing process. In contrast the walls of the container including portions of the container wall peripherally opposite the top end of the handle stem are free to be blown within the constraints of the mould.

With reference to Figs. 24-34 a second version of a preform, mould and resulting blown container is illustrated wherein first non-expanding region 30 is relatively long in the axial direction including a portion 140 which extends from locating ring 141 down to and around at least a top portion of the connection of the handle stem 130 thereby forming a join of the top end of handle stem 130 to locating ring 141. (Best seen in Fig. 24).

In this version there is at least partial expansion of wall portions of the preform located peripherally away from the join of the handle stem 130 to the preform 112 (best seen in Figs 32 and 34). This expansion, relatively, is not as great as the biaxial expansion occurring below the first and second non-expanding regions 30, 31. It can, however, be significant in providing strength and resistance to gas permeation in at least second non-expanding region 31, if not non-expanding region 30.

-19-

CONTAINER RESISTANT TO INTERNAL PRESSURES

With reference to Figs. 35 to 39 there is shown a container 150 incorporating an integral handle 151 which is biaxially blown from the preform 152 illustrated in Figs. 40 and 41.

In this instance, as perhaps best seen in Fig. 36, the blown container 150 includes a discontinuity region 153. In this instance the discontinuity region 153 extends the entire circumference of the container 150.

As best seen in Fig. 38 the discontinuity region 153 lies in a plane which subtends an acute angle α with a horizontal plane XX.

The plane of the discontinuity region 153 is oriented so that where it passes closest to the integral handle 151 it lies between first end 154 and second end 155 of the handle 151.

In this instance that part of the discontinuity region 153 located furthest from the handle 151 lies in the plane XX which passes through, or close to, join region 156 where the second end 155 of handle 151 is joined to container 150.

The discontinuity region 153 is formed by a substantial change in direction of the wall of the container 150, perhaps best seen in Fig. 35 wherein first tangent 157 to upper wall portion 158 intersects with second tangent 159 to lower wall portion 160 of container 150 at an obtuse angle β , thereby forming a portion of the discontinuity region 153.

This discontinuity region 153 imparts additional strength to the container walls, thereby to resist deformation of, particularly from internal pressures which can arise when the container is sealed, as for example when the container contains a carbonated beverage.

In order to assist in the creation of the discontinuity region 153 the preform 152 from which the container 150 is biaxially blown includes different wall thickness profiles, in this instance in the form of first

-20-

wall profile 161, second wall profile 162 and third wall profile 163 separated one from the other by first transition zone 164 and second transition zone 165 as best seen in Fig. 40.

5 It will be observed that the wall thickness of third wall profile 163 is greater than the wall thickness of second wall profile 162 which, in turn, is greater than the wall thickness of first wall profile 161.

10 The second end 155 of the handle 151 is joined to the container during a biaxial blowing operation by deflation and envelopment about the second end 155. The second end 155 can include a bulbous portion including a bulbous portion of the types illustrated in Fig. 2.

15 The preform 152 can be manufactured from PET materials in an injection moulding operation as described earlier in this specification.

20 The preform 152 is then blown as a second stage operation in a stretch blow moulding machine so that its walls conform to the inside surfaces of a mould, also as described earlier in this specification.

TAG CONNECTED HANDLE

With reference to Fig. 42 and Fig. 43 an alternative version of the container and the preform from which it is constructed are illustrated.

25 With reference to Fig. 42 the container 201 includes an integral handle 202 as previously described and constructed, save that the connection to the lower end of the container 201 is formed as an integral connection by way of a tag 203 which extends from a lower edge 204 of a wide part of the handle 202 down to a mid circumferential portion 205 of container 201 at which point it is integrally connected thereto. The lower edge 204 of the wide part of the handle 202 includes a landing portion 206 which merely rests on the surface of the container 201 at this point rather than being integrally connected thereto or otherwise connected thereto at this point.

30

35

-21-

A preform 207 from which the container 201 of Fig. 42 is blown is illustrated in Fig. 43. This preform 207 is constructed substantially in the same manner as that illustrated in Fig. 40 except that lower edge 204 of handle 202 is integrally connected to the preform 207 by way of tag 203 in the manner illustrated in Fig. 43.

The preform 207 is blown to form the container of Fig. 42 utilising the process previously described with reference to Figs. 10, 11 and 12.

The above describes only some embodiments of the present invention and modifications obvious to those skilled in the art can be made thereto without departing from the scope and spirit of the present invention.

INDUSTRIAL APPLICABILITY

Embodiments of the invention are applicable to the manufacture of containers made from orientable thermoplastics material and incorporating a handle or like grasping fixture as an integral component of the container.